A Project Report on

BeSafe: IoT Based Safety Band

Submitted in partial fulfillment of the requirements for the award
of the degree of

Bachelor of Engineering

in

Information Technology

by

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Approval Sheet

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Declaration

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Abstract

Women nowadays do not feel safe, either inside or outside of their homes. The crime rate is high, and accidents happen on every other route for various reasons. As a result, we proposed the idea of a safety band to help women and victims in critical situations. Given the circumstances, we devised a method for a woman to obtain administrative assistance on time. The Bluetooth module will help to connect hardware with software. We used a band for hardware and a mobile software application. Our technology will help women who have been sexually harassed, as well as victims of accidents or other crises, by tracking and communicating their real-time location, to the family and the police via Short Message Service (SMS) using the Global System for Mobile Communications (GSM) module and Global Positioning System (GPS) module while the victim is in the process of being tracked. Our method helps them remember the coordinates of where they pressed the push button. All data will be stored on Firebase and analyzed before reporting to law enforcement and government agencies. Based on the investigation's findings, the police may take further actions to help the victims.

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List of Abbreviations

GSM: Global System for Mobile Communications
GPS: Global Positioning System
SMS: Short Message Service
URL: Uniform Resource Locator
JSON: JavaScript Object Notation
IoT: Internet of Things

Chapter 1

Introduction

Women's safety is a hot topic in India. Currently, It has become a vital source of concern. The crime rate is increasing. Women are unsafe both outside and inside their homes. However, despite this fear, social activity will continue. Even if we have strict regulations, there should be adequate safety precautions that we must strictly follow to protect women from assault. The amount of violence against women has increased by many fold due to the greater exposure of women in every field of life. Women were previously restricted to the four walls of the houses and after globalisation they have got the chances and opportunities to stand equally in all sectors at par with male. Women are now a days cab drivers and they are also the CEO of top companies. It is a good sign that the patriarchal mind set of the society has changed to some extent but not to the extent it was supposed to. It is the same mind set that restricts women to go out and work making them as a tool for domestication. It is the same mind set that treats males as superior than female and always try to dominate the women folk. Eve teasing, sexual harassment, rape, domestic violence against women are these weapons used by the male to display the male superiority. This is one of the prime reason violence is increasing in India and women safety is a concern in India. Considering the above-stated circumstances, We have proposed a system that will quickly receive aid from family and the police. It is a hybrid of hardware and software that prioritises women's safety because only hardware or software won't provide complete security. The band serves as both hardware and software for mobile applications. Bluetooth enables hardware and software to exchange data. If a woman is in danger, an emergency switch located on the band should be pressed. As a result, in the event of an emergency, SMS will be sent to the user's family and police. Our system assists women who are victims of sexual harassment and is also designed to assist victims who are involved in a car accident or other crisis by tracking and sending their real-time location to the family via SMS using the GSM and GPS module when the band is connected to the application, The band will send a signal or either it will work independently. The user can send the Google Map Uniform Resource Locator (URL) link to the immediate family by pressing the push button. Our system will store the location area name where the push button was pressed, which could be useful to the police by allowing them to access data from Firebase or the application in JavaScript Object Notation (JSON) file format. For further data analysis to gather information the places where of the sos button was attempted. This way the government officials can tighten up the security or install cctv cameras in that vicinity. This way we can help the victim when they come across any problems.

Chapter 2

Literature Review

In 2019, S. Pandey et.al.[1] They proposed a methodology that uses an app a victim can send their location and log a complaint to a police station, family member, compatriots, and admin. The admin then forwards the victim's notification to all users within 100 metres of the victim. The App generates a unique code that allows two users to track each other. This would be more beneficial if it was completely automated and did not require monitoring. In 2018, N. R. Sogi et.al.[2]The proposed methodology uses a device for women's safety using a Raspberry Pi and a Raspberry camera module. The priority here is on helping the victim by informing the police or other designated parties of the victim's current location and information about the criminal with a single click of a button. The limitation includes the fact that this device is purposed to protect women and that obtaining assistance will be difficult due to the fixed access numbers. In 2019, V. Sharma et.al.[3]The proposed methodology consists of GSM, GPS, shock circuit, camera, Arduino UNO, and Raspberry Pi-3. When the user presses the switch, it sends the link to the guardians, with the live streaming video clips saved in the Google Drive link, activates the electric teaser for self-defence, and sends the location via the gsm module. The camera module is not able to be carried with the user. In 2019, R.R. Khandoker et.al.[4]The proposed system is an application where, if the user pushes the SOS button or yells with the voice command, the app will send an alert message to the user's registered contacts, including the user's position and record the surrounding sound for the first five minutes as a proof. The newer Android version has a restriction to listen to the sound continuously. In 2019, T. M. R et.al.[5]The authors designed a security device that included GPS, GSM, a Raspberry Pi, and various sensors. The smart band will provide the user's location and physical condition to the user's guardian and police. The proposed device is not wearable, it takes up a lot of space, and people cannot carry the band around. In 2019, S. Khanam et.al.[6]They proposed a better approach that uses a high voltage current producing circuit to stun the opposition for a few seconds. The fingerprint module for device activation and the GSM/GPS module for alerting and location tracking were all interfaced with a microcontroller to create a small baton-shaped device that is handy and portable. If there are too many people, it may be hard to use. In 2019, T. Sen et.al.[7]The proposed methodology uses a device that ensures women safety in three ways. They designed a mobile application that uses voice recognition. This device sends an alarm message to a preprogrammed number, rings the bell, records video, and aids in communication with an emergency number. It does not ensure the user's complete safety. The design is a little heavy, making it unwearable. In 2020, A. Anand et.al.[8]The proposed system uses Firebase, Twillio, MapBox API in their application. They have designed a crowdsourcing application. Whenever the user is in trouble and presses the SOS button, It will notify other users nearby by sending the real-time

location. The MapBox API update's position on an hourly basis of the user. But it has privacy concerns where other individuals may become a threat. In 2020, H.Chaudhary et.al.[9]The proposed system uses a band for children and GPS-enabled smartphones for parents to track their children's positions. The child's finder can utilise the information stored on the wristband to locate the youngster. The band has parents contact information, as well as a QR code. The app's difficulties include the lack of automatic calling to responsible persons when the system detects the youngster has gone missing. In 2020, Z.A.M. Fernandez et.al.[10]The proposed system used Artificial Intelligence for Speech Recognition, Accelerometer and Gyroscope for human activity recognition. The Application will detect the dangerous situation. The Algorithms will recognise the condition and forward it to a Firebase that will send alert messages with GPS Coordinates and the recorded video link. But it doesn't provide the specific places with the most insecure and finding strategies to put users in a safer situation. In 2020, A. Z. M. Tahmidul et.al.[11]The proposed methodology is an Android app and an Internet of Things (IoT) device to make women's movement safer. The app also provides the user with the location of the nearest safe zone. The app can transmit a notification to the nearest police station and volunteer support. The software has a flaw that causes the transmission of SMS to volunteers in a different zone. In 2020, V. Mishra et.al.[12]The proposed system uses SQL for the database, voice recorder, and GPS for getting coordinates. It gathers the required information, like personal and contact details. The application is activated when the user shakes the phone, uses voice, or presses the button present in it. It sends the latitude and longitude coordinates to the contacts via SMS and records audio for proof. The system could have sent the map URL link instead of sending the latitude and longitude coordinates. In 2020, D.V. Savla et.al.[13]They designed a safety band that uses data thresholding algorithms and a Wi-Fi-enabled microprocessor to detect falls. If there is a fall or spike, the server starts a 30-second timer. The user can cancel the emergency using the cancel button while the timer is still running. It conveys the nature of the crisis, user information, and precise position. The system can introduce a mobile app with live tracking and additional data analytics. In 2020, D. Sunehra et.al.[14]The proposed system is, implemented using the Raspberry Pi3 to improve the safety and security of women/children. It sends a buzzer alert to people who are close to the user. It locates the user using the GPS transmits via SMS to the emergency contact and police using the GSM. It interfaces with a USB Web Camera and sends an e-mail alert to the emergency contact. The system can be portable by enclosing all components in a small enclosure and using batteries. In 2021, K. Venkatesh et.al.[15]They proposed a device that has a wearable "Wrist band" that constantly communicates with a smartphone. The device includes a trigger, GSM module (SIM800), GPS module (Neo-6M), IoT module (ESP-12E), Neuro Stimulator, Buzzer, and Vibrating Sensor. The IoT device helps to track the surroundings and inform the internet tab. The proposed device is not wearable, it takes up a lot of space, and people cannot transport it.

The application developed will be a cross-platform application. So, It can run on both IOS and Android. The app will send the Google Map URL links instead of coordinates. The application will have a feature to show safer locations for the user, to get there in a dangerous situation. It will ensure the privacy of the users. The solution we proposed includes both hardware and software. The band provides hardware assistance when the victim does not have access to a mobile phone during a crisis.

Chapter 3

Objectives

- To achieve the location of the victim we will be using the GPS and GSM module which will help their family to locate them.
- To develop an application compatible with multiple OS like Android and iOS.
- To achieve the current location it will be converted into a Google Map URL link and send through cross platform application to the concerned one.
- To store the emergency location data in cloud for data analysis.
- To analyse the data/logs received from all the users so that it can be further used by police to identify the areas where emergencies had occurred with the help of bluetooth module which will send the data to the application and stored into the firebase.

Chapter 4

Project Design

4.1 Existing System

4.1.1 Flow of Band

When the user will turn on the device, all modules will be launched simultaneously. The band will check whether the emergency switch has been pressed twice within five seconds or not. If the switch is not pressed or pressed for a single time, the band will not take any further action. But if the band user is in danger and presses the emergency switch on her band twice within five seconds, an emergency SMS will be sent immediately to the nearest police box, volunteers and her family. Police boxes and some volunteers' mobile number of each branch will be provided to the system in advance. When the emergency switch will be pressed, the emergency message will be sent to the police and volunteers of that zone in which the user will be in. If a user presses the button from a vehicle, the emergency SMS will be continuously sent with her updated location after every thirty seconds to the police until she presses the emergency button four times. As vehicle can go from one area to another in a very short time, if the vehicle enters the next zone then the system will send SMS to the previous zone volunteers and also to the new zone volunteers.

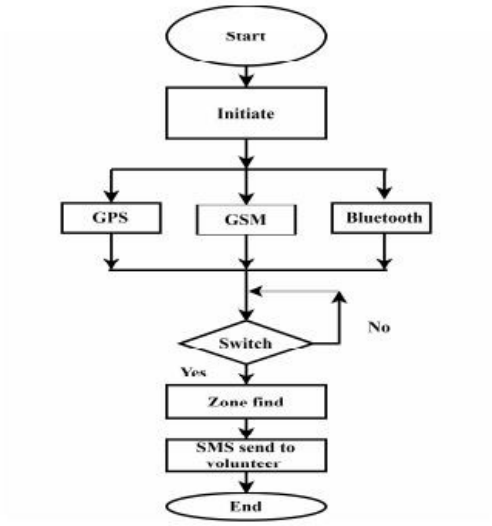

Figure 4.1: Flow of Band

4.1.2 Flow of Application

The user can trigger the app in two ways. One is through the emergency switch in the app. Another one is the emergency button with Smart band, which transmits signals with the app using Bluetooth support. When the emergency switch is pressed, the system will see if the GPS is ON. If not, the app will turn on GPS location service. The system will be informed about the current location of victim through Google Geolocation Service. The app will then send a notification via the Firebase Notification Service to the closest active user of the victim. As a result, the volunteers will reach out to help her and the attacker will not have enough time to harm the victim. The smart band shown in the figure above will be worn by the women like a watch. Here, the white color push button acts as the emergency switch. The HC-06 Bluetooth module connects between this band and the app.

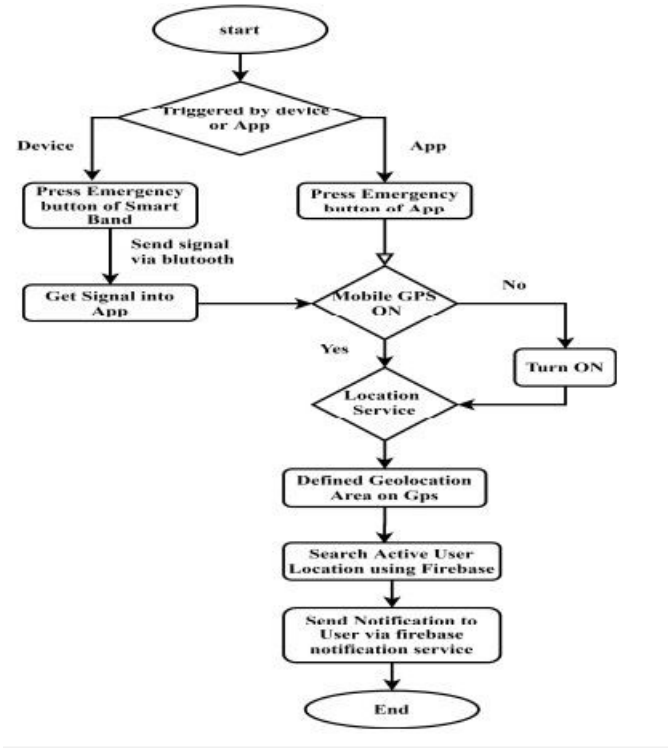

Figure 4.2: Flow of App

4.2 Proposed System

The system we proposed includes a band and a cross-platform application for a woman to receive assistance. We prioritised women's safety above all else, so we created a system that combines hardware and software. It will assist women in a desperate situation, accident or other crisis by tracking and sending their real-time location to the emergency contacts as an SMS via the GSM module. After tracing the current location, it will be converted into a Google Map URL link and sent either by a band or a cross-platform mobile application. Our proposed system can store the GPS coordinates of the location where the victims pressed the help button so that the police can view the records for investigation purposes in the future by accessing the JSON

data. In an emergency, we have two techniques in our system for ensuring the safety of female victims: an IoT-based band or a cross-platform application via a smartphone.

4.2.1 Flow of Proposed Band

When the IoT-based band has started, it activates all modules, including GPS, GSM, Bluetooth, refer to the below Fig. 2. After then, the band will check to see if the emergency button is active. If the victim presses the switch, the antenna will collect the signal, and then it will be monitored by the GPS module. The band must ensure that all modules have permitted if the network is not connected. When the computer shows the longitude and latitude using the signals received by the antenna, the coordinates are confirmed. When the victim is in a crisis, the coordinates are communicated to the police and emergency contacts via an SMS via GSM module in link format.

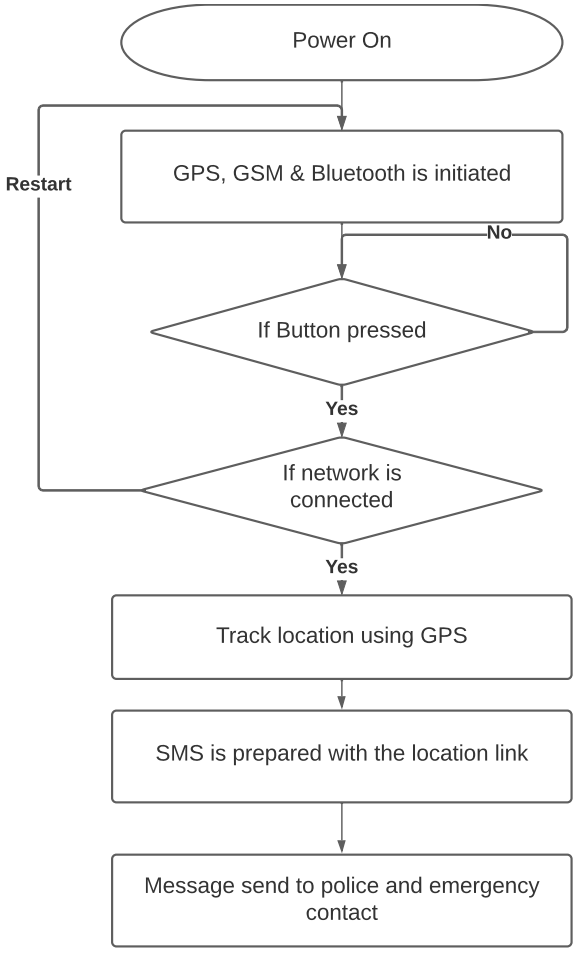

Figure 4.3: Flow of Proposed Band

4.2.2 Flow when APP and Band are connected

When the IoT-enabled band is activated and connected to the application, the band alert all of the modules GPS, GSM, and Bluetooth. The safety band sends the Bluetooth signal to check the connection with the application. The safety band will also relay the victim's current location

if the location is on. It would also communicate the location coordinates to the victim's emergency contacts. When the victim presses the SOS button, the app sends the victim's current position to the emergency contacts. Whenever the band would connect to the mobile app, the coordinates would be saved and accessed from the Firebase. Refer to the below Fig. 3.

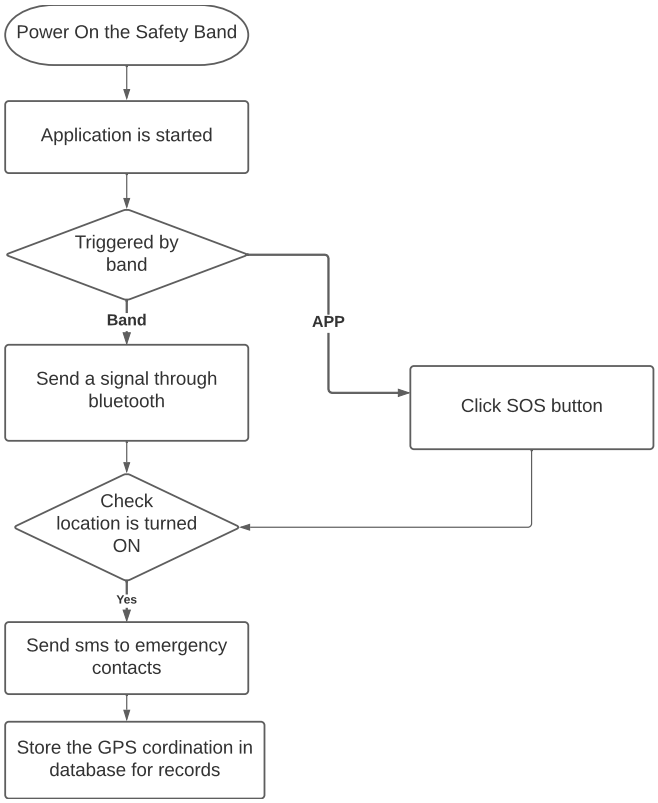

Figure 4.4: Flow when APP and Band are connected

4.2.3 Flow of Proposed Application

After starting the application, the user must register and give personal details stored in Firebase, including emergency contacts stored in the local database. The verification of the user's e-mail will be taken care of by FirebaseAuth. If the user presses the SOS button, it will fetch the coordinates with the help of Geolocator and convert them as a Google Map URL link, And then the application will retrieve contacts from the local database. The telephony package will send the message to the emergency contacts retrieved with the link present in it. Then, Geocoding will convert coordinates into sub locality names and store that data in Firebase Cloud Storage, refer the below Fig. 1. The admin can access that data from the application in a JSON file format refer Fig. 5. That will further be useful for data analysis of the most unsafe places, Which be helpful for government officials to investigate or to place CCTV cameras.

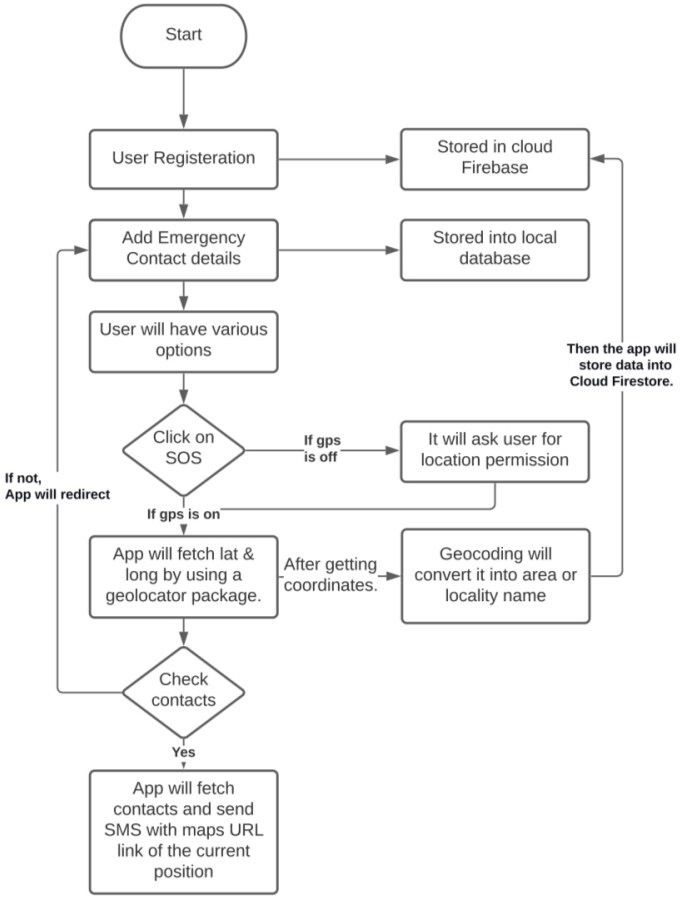

Figure 4.5: Flow of Proposed Application

4.3 UML Diagrams

4.3.1 Use Case Diagram

Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. Hence, when a system is analyzed to gather its functionalities, use cases are prepared and actors are identified. In this use case diagram, we have defined what use cases will be available for the primary actor like the user. And the use cases need a secondary actor like FirebaseAuth, Safety Band, Database and Firestore in Fig 3.1. Some use cases have included use cases or extended use cases e.g. while login, App needs to verify the email and password details before directing the user into the application. So, the login use case must have verify but it may not be necessary to have a login error use case every time. Some use cases need to be performed on the secondary actor side like for verification app sends the request to firebase for authentication. The user can log in, Register, Connect the safety band, Look for safe places, Make an emergency call, Add or Delete contacts, View his/her current location and The Location data can be accessed from the Analysis use case.

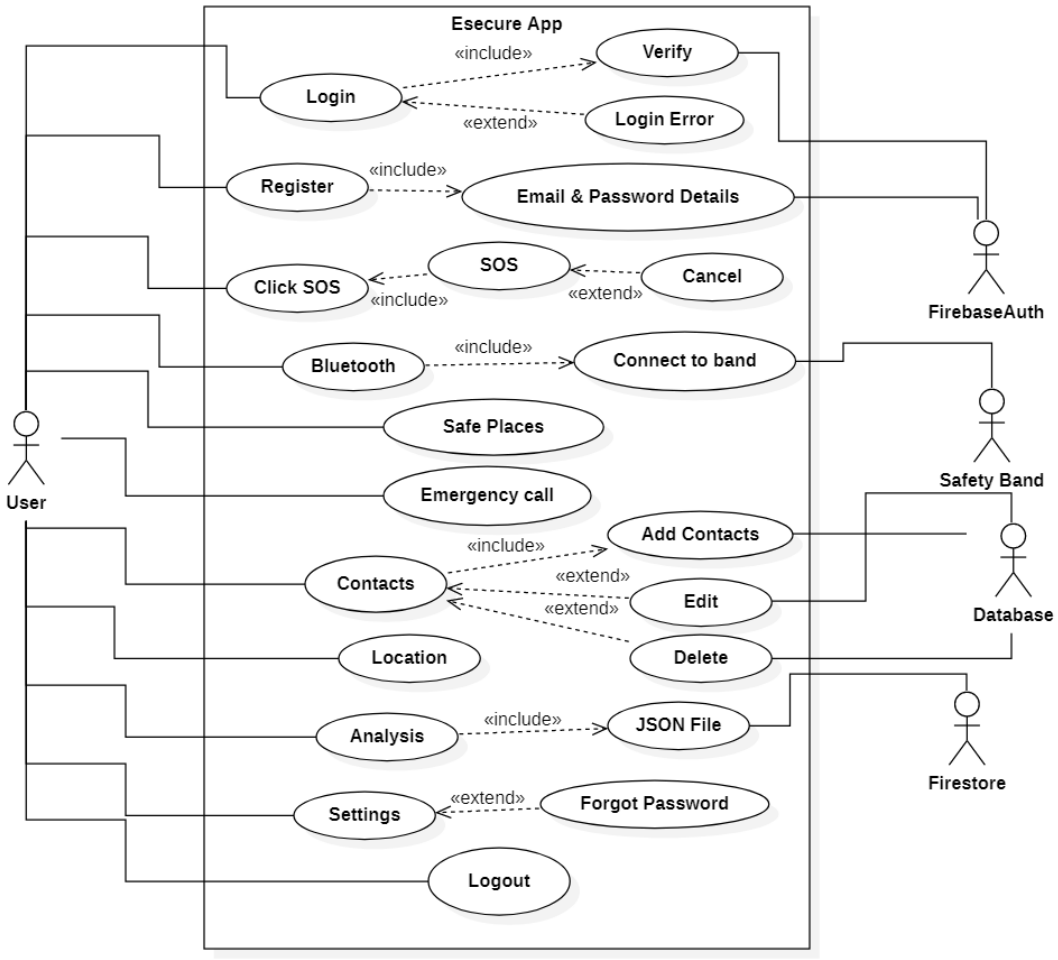

Figure 4.6: Use Case Diagram for Esecure App

4.3.2 Activity Diagrams

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc. In this activity diagram, we will discuss the login flow. When the app is started user will have two options either to register or log in. When the user clicks register, the user must enter the details and it will check the fields and redirect to the home page. Likewise, the login will also verify with FirebaseAuth then redirect to the Home Page in fig 3.2. This shows the control flow of the login. On the home page, The users have multiple actions to perform like Side Menu, Bluetooth, SOS, Safe Places and Speed Dial. Under Side Menu, It has different actions like Settings, Analysis and Logout. The Bluetooth action is to connect the safety band. The SOS is the action the user wants to use while in an emergency. The Safe Place actions will redirect to google maps for direction. The Speed Dial action has three more under it Emergency call, Current Location and Contacts in fig 3.3. This shows the control flow inside the application.

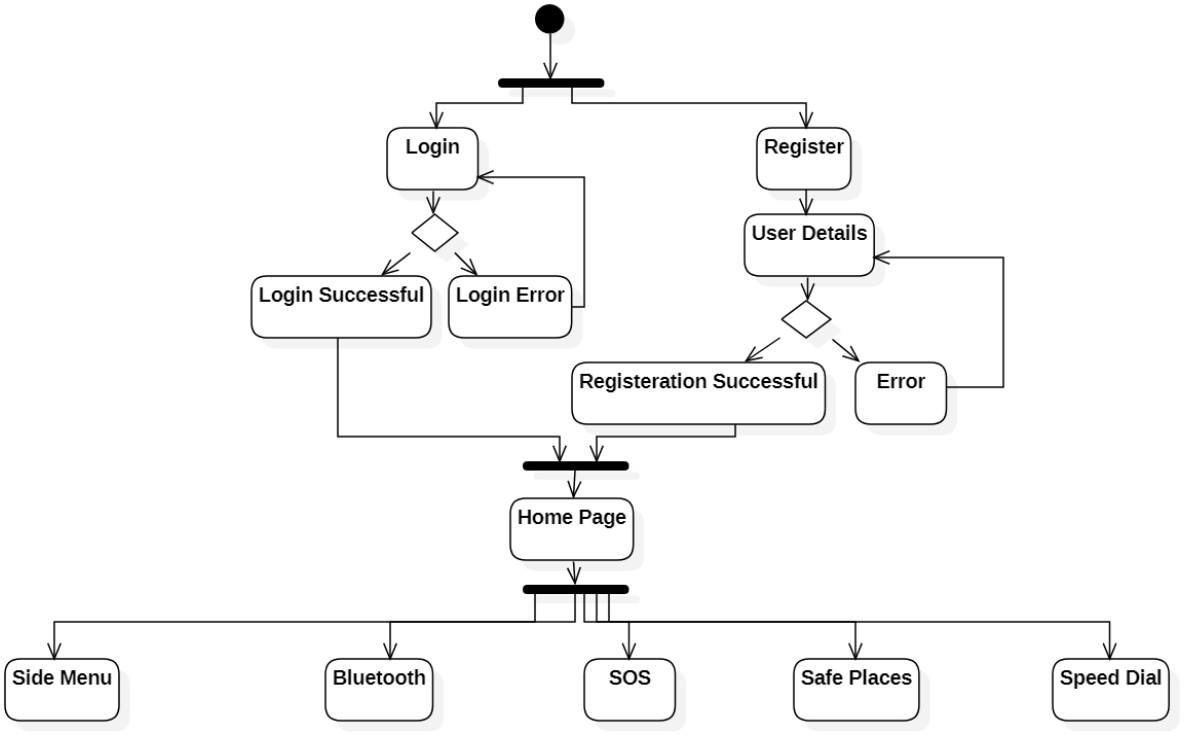

Figure 4.7: Activity Diagram for Login

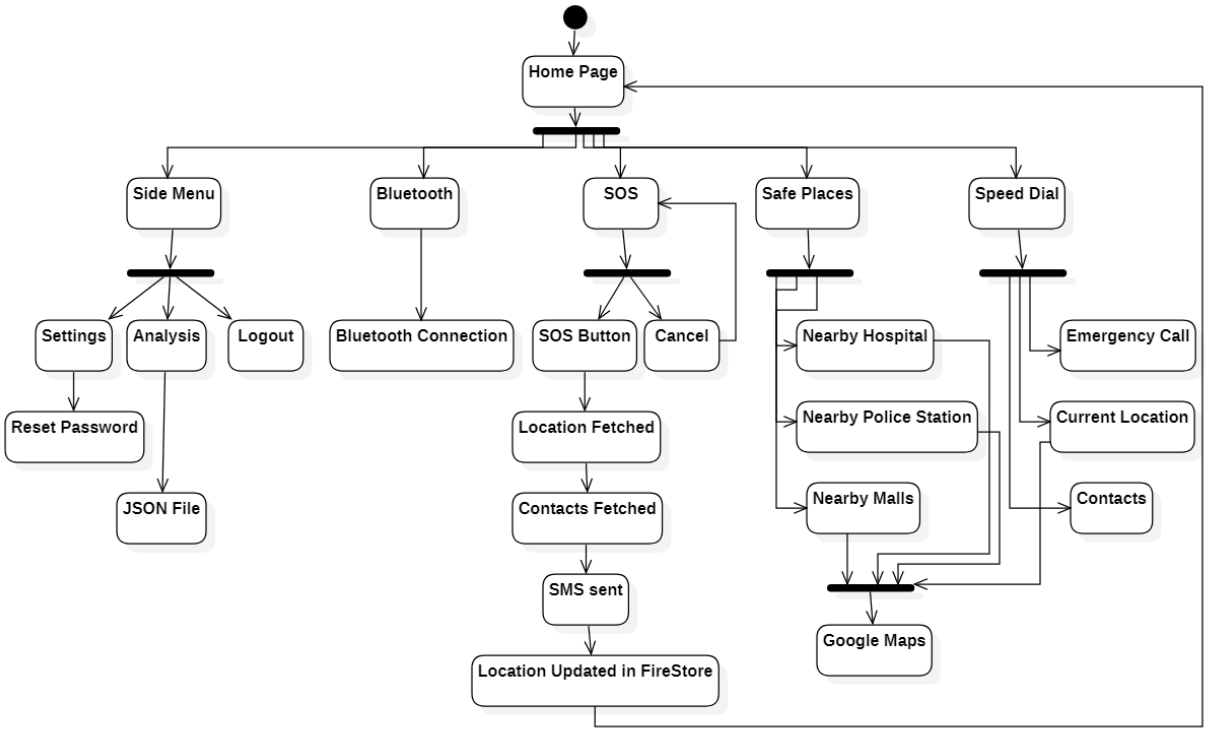

Figure 4.8: Activity Diagram for Home

4.3.3 Class Diagram

Class diagram is a static diagram. Class diagram describes the attributes and operations of a class and also the constraints imposed on the system. In the class diagram, the login class is the main class which is the first thing to execute before implementing different methods. The attributes needed for the login class are email and password. And the operations performed are checking the fields, validating email and authenticating the user to log in. The snapshot of the user details is stored. So, The user doesn't need to log in every time using the application. The handleAuth operation checks the state of user details and redirects to the home page in fig 3.4. The user then can perform different actions from the classes on the home page. In the side menu, the settings will use to reset the password, the analysis will use to download JSON files and logout will directly log the user out of the application. The SOS class will perform functions like fetching location, fetching contacts, starting the timer, updating the location in the Firestore. If it is a false call, the stop timer will execute. The Bluetooth class will have operations like scanning the devices, connecting or disconnecting the device. The Speed Dial class have subclasses like making an emergency call, adding, deleting, editing or viewing the contacts and location will track the current location.

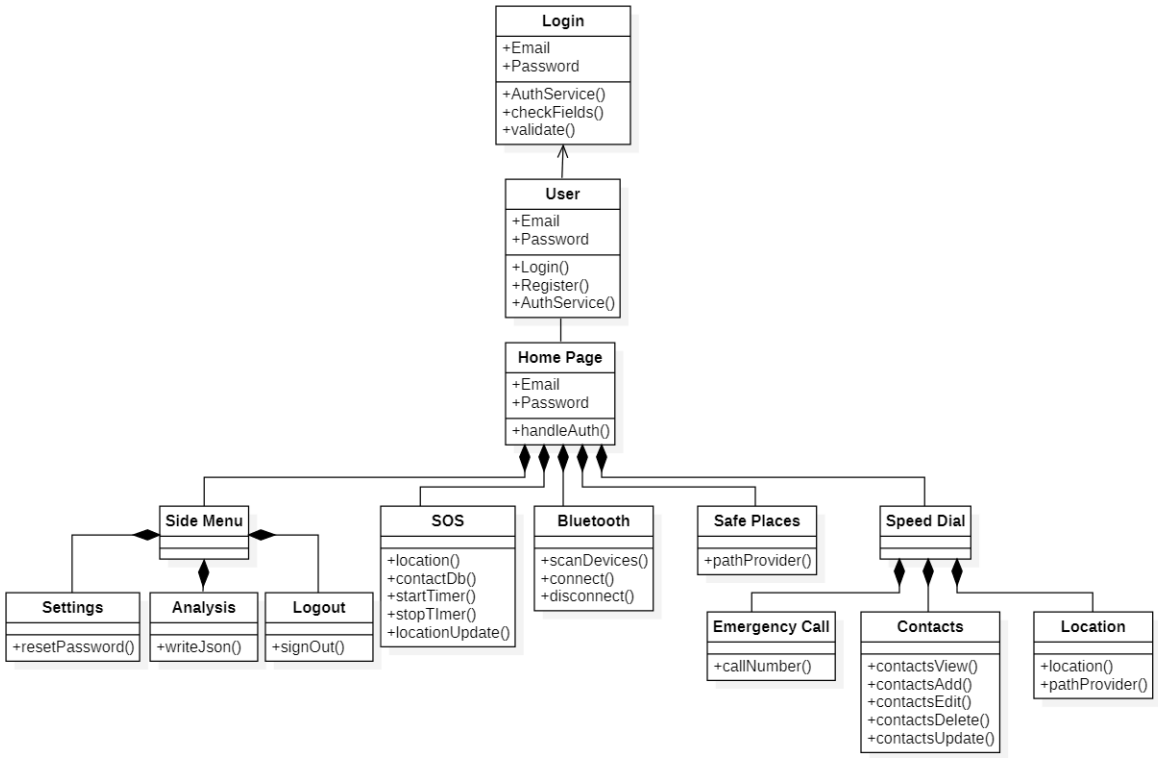

Figure 4.9: Class Diagram for Esecure App

4.3.4 Sequence Diagrams

The sequence diagram is used primarily to show the interactions between objects in the sequential order that those interactions occur. And to understand the process flow and the active time when the user is interacting with the application. In fig 3.5, The process flow is when the user interacts with the application for the first time. The user must click on register and enter the details. The app will validate the email and redirect the user to the Home Page. The user has to add contacts before using SOS in an emergency. The flow starts when the user adds a new phone number for the first time, The application will create a contact table and stores the contact details in the table. The other operations like Edit and Delete will be performed according to the user. In fig 3.6, The process flow is when the user wants to reset the password. The user needs to give a valid email. Then the FirebaseAuth service will send a reset link to the registered mail. The process flow when the SOS is clicked. The user will see the timer has started, If it was a false alert the user can directly cancel it before the time runs out. Either way, if it was an emergency after the time runs out. The application will fetch the current position, contacts and will send an SMS with a map link. The sending of an SMS will be in a loop till every phone number given by the user has received an SMS. The application will also be able to download a JSON file with location data in it, which will be read from the Firestore and written in JSON file format.

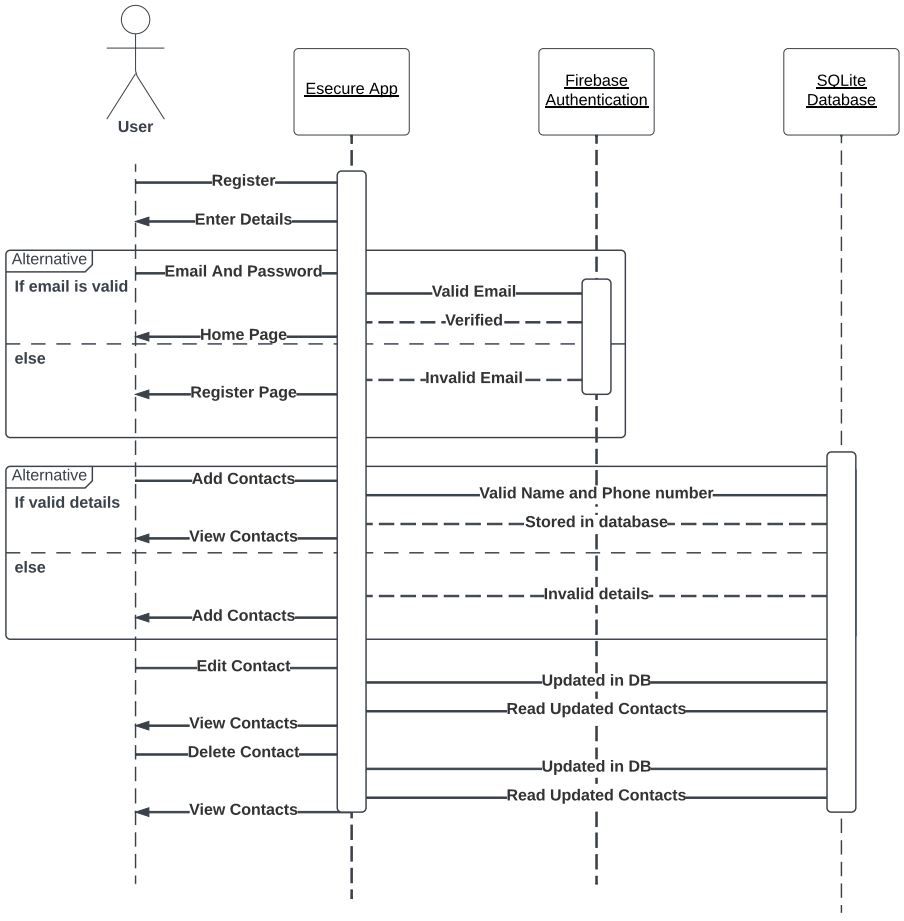

Figure 4.10: Sequence diagram for Login and Contacts

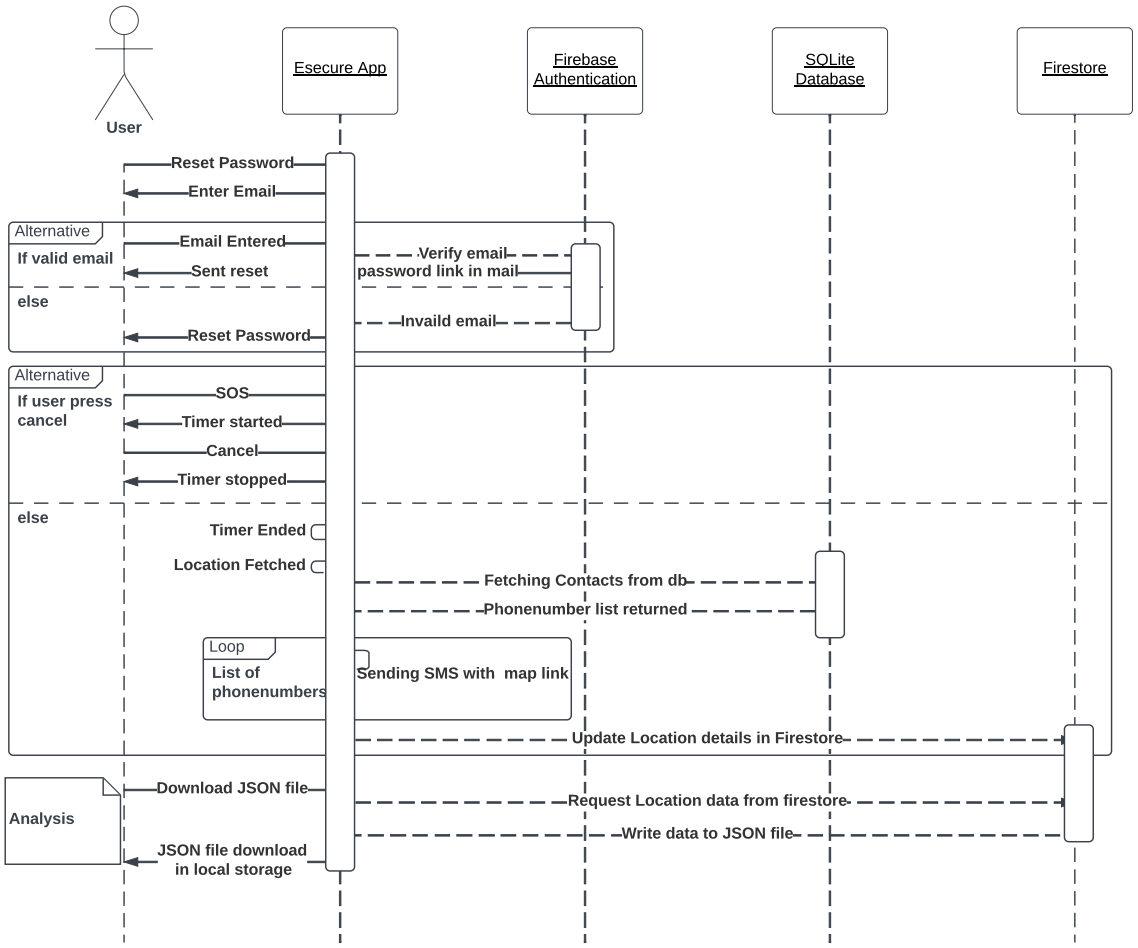

Figure 4.11: Sequence diagram for SOS and Analysis

Chapter 5

Project Implementation

5.1 Application Implementation

5.1.1 AuthService

The AuthService class is the main one to check the state of the user credentials. It decides whether the user is authentic. And the user doesn't need to log in every time he uses the application fig 4.1. It will help when the user logouts AuthService will change the user credentials with a new one if the user uses another mail id. So, this is the security check that unauthorized users can't access the homepage.

```
class AuthService {
  //Determine if the user is authenticated.
  handleAuth() {
    return StreamBuilder(
        stream: FirebaseAuth.instance.authStateChanges(),
        builder: (BuildContext context, snapshot) {
          if (snapshot.hasData) {
            return HomePage();
          } else
            return LoginPage();
        }); // StreamBuilder
  }
```

Figure 5.1: AuthService

5.1.2 Location

The Location function is the crucial part of the code used to track the current location. It first asks the user to give permission to access GPS to the app. The getCurrentPosition method returns all the requests to the Geolocator package fig 4.2. The Instance of the Position object is to get the latitude and longitude. The placemark is to convert the coordinates into place/area names. It comes under geocoding package and can return multiple information like country, state, locality, sub locality names etc.

```dart
Future<Position?> _getGeoLocationPosition() async {
  bool serviceEnabled;
  LocationPermission permission;
  // Test if location services are enabled.
  serviceEnabled = await Geolocator.isLocationServiceEnabled();
  if (!serviceEnabled) {
    // Location services are not enabled don't continue accessing the position and reque
    // App to enable the location services.
    await Geolocator.openLocationSettings();
    return Future.error('Location services are disabled.');
  }
  permission = await Geolocator.checkPermission();
  if (permission == LocationPermission.denied) {
    permission = await Geolocator.requestPermission();
    if (permission == LocationPermission.denied) {
      return Future.error('Location permissions are denied');
    }
  }
  if (permission == LocationPermission.deniedForever) {
    // Permissions are denied forever, handle appropriately.
    return Future.error(
        'Location permissions are permanently denied, we cannot request permissions.');
  }
  // When we reach here, permissions are granted and we can
  // continue accessing the position of the device.
  Position position = await Geolocator.getCurrentPosition(
      desiredAccuracy: LocationAccuracy.high);
  setState(() {
    currentPosition = position;
  });
  return null;}      You, 1 second ago • Uncommitted changes
```

Figure 5.2: Tracking current location

5.1.3 The Emergency Button

This function integrates all the methods in one single module. It is the most critical part of the code. It calls all the future functions, that's why we have used async to wait for the future function to return the output. It calls getGeoLocationPosition which is a tracking current position function. The currentAddress variable is defined with the result of the Position instance in the form of a string. The message is defined with a link variable. The getContacts function is called to get all the phone numbers from the database in the form of a list. The app will now take permission from the user for sending SMS. If the permission is granted the for loop will send the SMS to phone numbers from the list. Finally, The current position data will be added to FireStore.

```
void onSosTap() async {
  await _getGeoLocationPosition();
  String currentAddress = currentPosition.latitude.toString() +
      "," +
      currentPosition.longitude.toString();
  String link =
      "Help I'm in danger this my location:\n" + mapLink + currentAddress;
  List<dynamic> phoneNumber = await _contactHelper.getContacts();
  bool? permissionsGranted = await telephony.requestPhoneAndSmsPermissions;
  if (permissionsGranted == true) {
    for (String number in phoneNumber) {
      await telephony.sendSms(
          to: number, message: link, statusListener: listener);
    }
  }
  await location
      .add({'areaname': currentLocation})
      .then((value) => print('location updated'))
      .catchError((e) {
        ErrorHandler().errorDialog(context, e);
      });
}
```

Figure 5.3: SOS Function

5.1.4 Analysis

The write JSON function is for the analysis part. The function first asks the user for permission to access the storage for writing data to the file. Before writing to the file, It gets the path from the local file function it needs to await as it is a future function. Then we will create an instance for having a snapshot of cloud DB and get a location document, which contains the area name as a key and the value as an actual area name. All the data in that document will be defined as a variable. Now, we will encode to JSON file with the input from the variable. Now the function will check the permission is allowed. The file will be written in the hardcoded path.

```
Future<void> _writeJson() async {
  _filePath = await _localFile;
  QuerySnapshot querySnapshot = await location.get();

  // Get data from docs and convert map to List
  final allData = querySnapshot.docs.map((doc) => doc.data()).toList();
  _jsonString = jsonEncode(allData);
  print('3.(_writeJson) _jsonString: $_jsonString\n - \n');

  //4. Write _jsonString to the _filePath
  _filePath.writeAsString(_jsonString);
}
```

Figure 5.4: Downloading JSON File

5.1.5 Hardware Code

We have used GPS library “TinyGPS” and “SoftwareSerial” for communication between GPS, GSM and Bluetooth. We have included a buzzer in the hardware for safety of the victims, So that it will buzz in emergency when the switch is pressed. We have assigned the receiving and transmitting pins in the code. We have taken GSM module which is a wireless radiation monitoring through short messaging service. We integrated it with Bluetooth module and called the sim in GSM at 2000 millisecond delay. It then initiates the SMS and sends it to the registered mobile number stating "HELP!! I AM IN TROUBLE." along with google map link having the coordinates.

```
void gsm(String value1, String value2){
  ss.end();
  sim.begin(9600);
  Serial.println("In GSM");
  sim.println("AT"); // Configuring TEXT mode
  delay(2000);
  ShowSerialData();
  sim.println("AT+CMGF=1"); // Configuring TEXT mode
  delay(2000);
  ShowSerialData();
  sim.println("AT+CMGS=\"+919322225427\"");
  //change ZZ with country code and xxxxxxxxxxx with phone number to sms
  delay(2000);
  ShowSerialData();
  String SMSsentlast1 = "HELP!! I AM IN TROUBLE.";
  String SMSsentlast2 = "www.google.com/maps/search" + String (lat1)+ String(long1);
  sim.print(SMSsentlast1); //text content
  sim.print(SMSsentlast2); //text content
  delay(1000);
  ShowSerialData();
  sim.write(26);
  delay(5000);
  sim.end();
  bt.begin(9600);
  bt.print(SMSsentlast1); //text content
  bt.print(SMSsentlast2); //text content
  bt.end();
  ss.begin(9600);
  Serial.println("GSM-GSM Out");
}
```

Figure 5.5: Hardware Code

Chapter 6

Testing

6.1 Functional Testing

6.1.1 Unit Testing

Unit testing is the first level of testing and is often performed by the developers themselves. It is the process of ensuring individual components of a piece of software at the code level are functional and work as they were designed to. Developers in a test-driven environment will typically write and run the tests before the software or feature is passed over to the test team. Unit testing can be conducted manually. Unit testing will also make debugging easier because finding issues earlier means they take less time to fix than if they were discovered later in the testing process.
The Unit testing is best suited for our application development phase. In that phase, we started to code in units create different modules. And test each module separately, like the login page, register page, home page, contacts page, emergency screen, analysis page etc. All these pages are tested and debugged before going further integrating. And check whether we are getting the desired output from each module as for the objectives.

6.1.2 Integration Testing

After each unit is thoroughly tested, it is integrated with other units to create modules or components that are designed to perform specific tasks or activities. These are then tested as group through integration testing to ensure whole segments of an application behave as expected (i.e, the interactions between units are seamless). These tests are often framed by user scenarios, such as logging into an application or opening files. Integrated tests can be conducted by either developers or independent testers and are usually comprised of a combination of automated functional and manual tests.
As we have discussed unit testing the next step is integration testing. All the units which we have tested and debugged are now ready to integrate into a whole single module. The integration part is crucial as we need to know which unit must interact without error, calling them in a different class accessing the instance of that class all these can be cleared with help of the sequence diagram which was represented in Project Design. So accordingly, modules are integrated and checked whether they behave as for the objectives.

6.2 Non Functional Testing

6.2.1 Compatibility Testing

Compatibility testing is used to gauge how an application or piece of software will work in different environments. It is used to check that your product is compatible with multiple operating systems, platforms, browsers, or resolution configurations. The goal is to ensure that your software's functionality is consistently supported across any environment you expect your end-users to be using.
The framework we are using to develop our application is Flutter. It is an open-source framework by Google for building beautiful, natively compiled, multi-platform applications from a single codebase. We make sure that our application is compatible with both IOS and Android operating systems. The features we developed are perfectly run in multiple operating systems without an error. For this reason, compatibility testing is best suited for our project.

6.3 Test Cases

TC	Name	Expected Output	Actual Output	Status	Comment
1	Email and Password Validation	Accept only after requirements met	Accepting only after requirements met	Pass	Email and Password validated successfully
2	Register	Add user in the Firebase	Adding user into the Firebase	Pass	Registered successfully
3	Forgot Password	Send reset link to the registered mail	Sending reset link to the registered mail	Pass	Email validated successfully
4	Location Tracking	Track the current position coordinates	Getting the desired position coordinates	Pass	Location Tracking successfully
5	Sending SMS	Send SMS to the contacts	Sent SMS to the to the contacts	Pass	Sending SMS successfully
6	Emergency Call	Make a emergency call just by a tap	Dialling the emergency call just by a tap	Pass	Emergency call service successful
7	Safe Places	Show Safe Places just by a tap	Showing Safe Places just by a tap	Pass	Safe Place service successful
8	Contacts Screen	View, Add, Edit and Delete from the database	All the features works accordingly	Pass	Contact Screen service successful
9	Location Update	When SOS pressed add location data in Cloud Firestore	Application adds data in Cloud Firestore	Pass	Location Updation successful
10	SOS Button	When SOS pressed TC 5, 6, 9, 10 should execute	All the required TC executes when SOS is pressed	Pass	SOS Button successfully executes
11	Analysis Screen	Fetch Location Data and convert it into JSON file format	JSON file is downloaded in the device	Pass	Analysis done successfully

Table 6.1: Application Test Cases

Chapter 7

Result

7.1 Login Screen

We have implemented a minimalistic UI that if a user firstly interacts with an application, it would be more attractive and user friendly. When the user interacts with the application first time can register and log into the application. If the user is already registered but forgot the password there is a forgot password option available simply by clicking it user can reset the password. After login, the user will be able to access the home page.

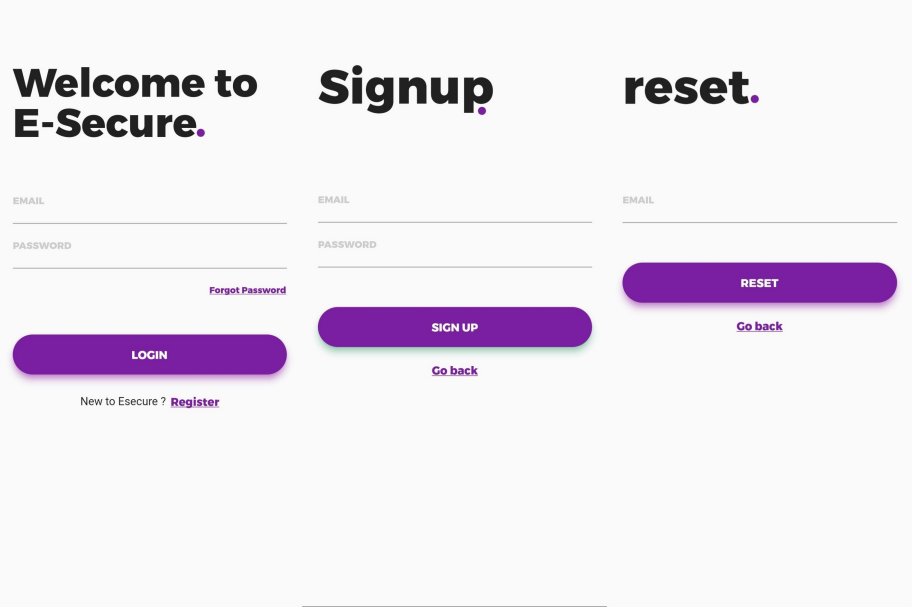

Figure 7.1: Login and Register Screen UI

7.2 Home Screen

We make sure that users can have access to different features just by a click and are visible and easily understandable. There are features to access for the user whenever they are in an emergency like Safe Places and SOS emergency. The user can also add contacts so whenever

there is an emergency they will receive an SMS. If they want to call the emergency helpline they can click on the emergency call. The user can also reset the password from the settings option.

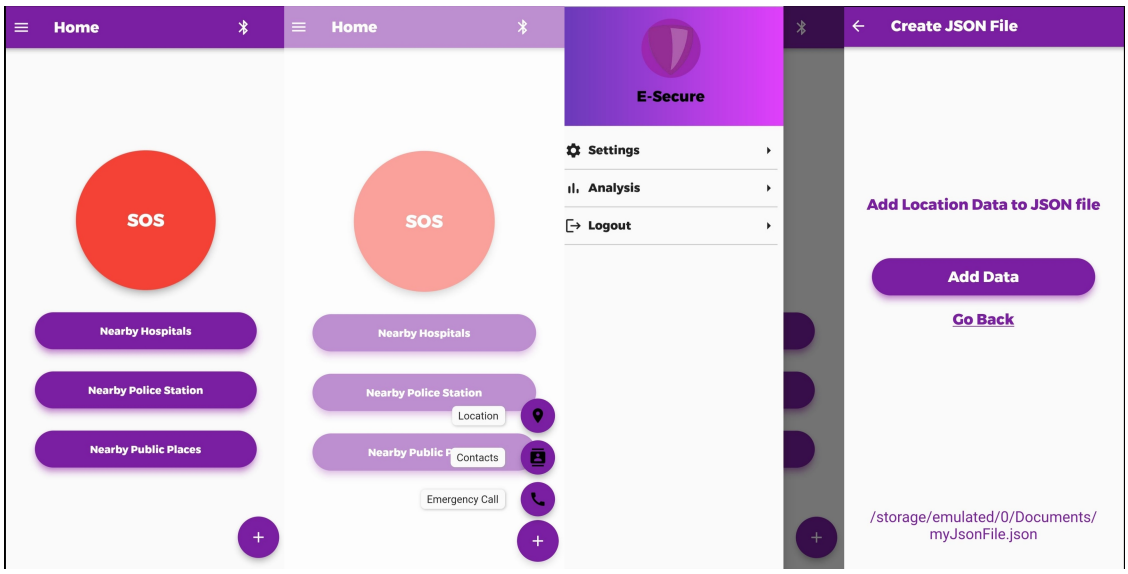

Figure 7.2: Home and Analysis Screen UI

7.3 SOS and Contacts Screen

Before accessing the SOS feature the user must give the contacts in the contact screen. The SOS feature triggers a timer for 10 secs so the user can cancel it if it was clicked by mistake. After 10 secs it will fetch the current coordinates and also the contacts from the database. Then it will send alert messages to the contacts provided. And in the last, it will add the location data to the cloud for data analysis. The user can also delete or edit the contacts accordingly.

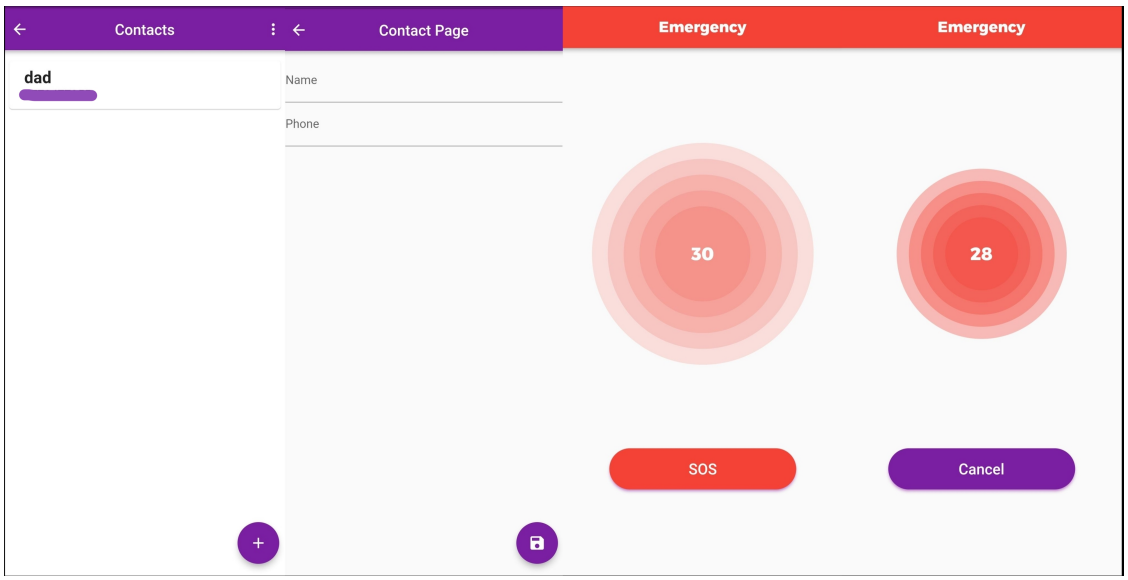

Figure 7.3: SOS and Contacts Screen UI

7.4 Bluetooth Screen

With the integration of the band with the app, we have given the option of Bluetooth to connect with the application. It will show the list of Bluetooth devices available. The Bluetooth part is used for a location update. If the user is in an emergency but cannot access the phone. So the user can press the button on the band for sending an alert message. The location which was fetched from GPS on the band will be stored in a variable. When the user connects the band to the application the band will send the coordinates to the application, It will then store it in Firebase for data analysis.

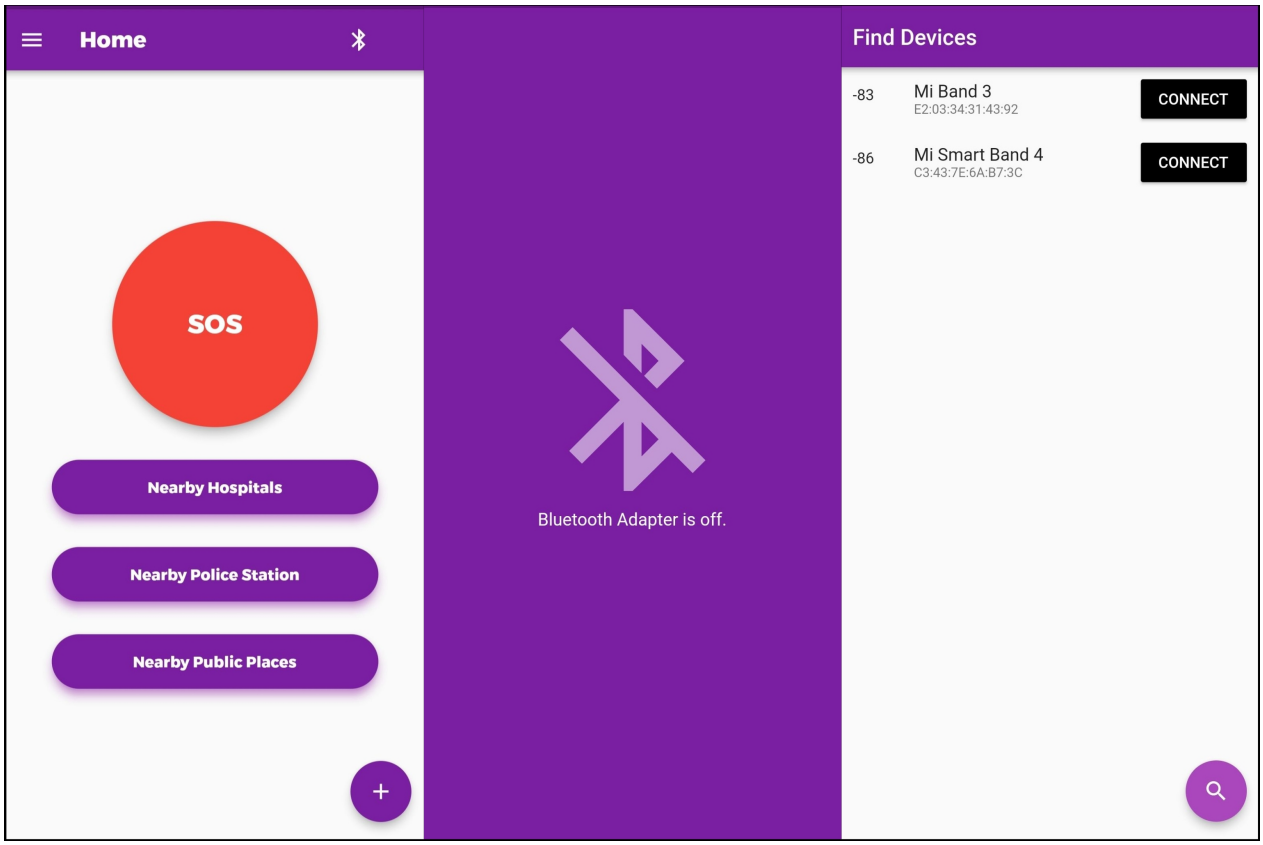

Figure 7.4: Bluetooth Screen UI

7.5 Hardware Result

We utilised the arduino nano as a microcontroller in our circuit and GSM 800 as a modem. We've put the components to the test, as well as their interconnection. We've completed the circuit's testing and connection. We built the hardware that allows all of the GPS, GSM, and Bluetooth modules to send SOS messages to the smart phone. The longitude and latitude will be sent by the GPS to the GSM module, which will help transform them into a message format. The user's location will be included in the message sent to the smart phone.

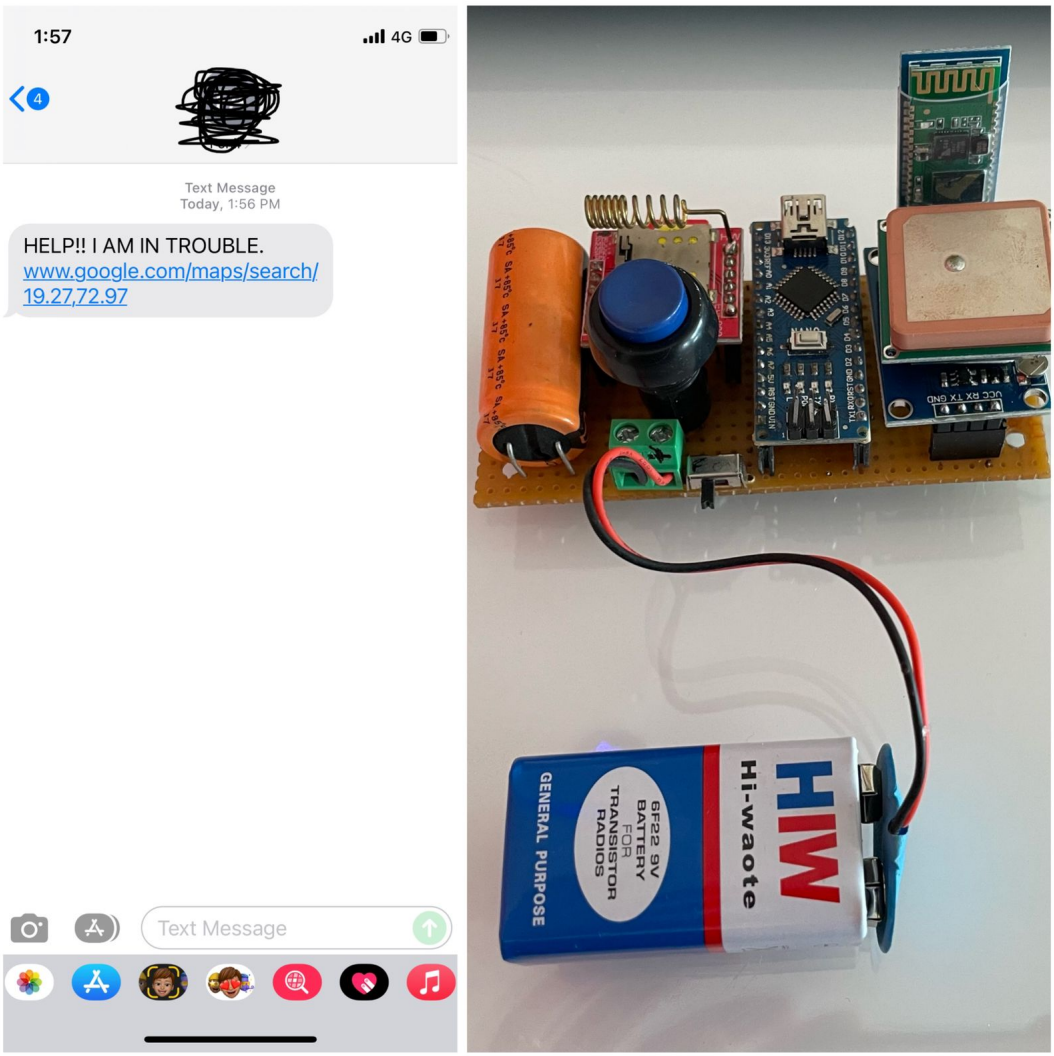

Figure 7.5: Hardware

Sr.no	Project Title	Features	Android Support	IOS Support	IoT Device Support
1	BeSafe: IoT Based Safety Band	send sms with google map link, emergency contacts, safe places and analysis, location data update.	Yes	Yes	Yes
2	Reach360: A comprehensive safety solution	share location send sms and location shake to unlock	Yes	No	No
3	Smarisa: a raspberry pi based smart ring for women safety using iot	share location send sms with location alarms and capture images	Yes	No	Yes
4	Smart shoe for women safety	Electric Teaser, send coordinates as sms, record video, alert by buzzer	No	No	Yes
5	Women's safety system by voice recognition	shake to alert send coordinates as sms record voice alert by voice	Yes	No	No
6	Raspberry pi based smart wearable device for women safety using gps and gsm technology	send location as sms, sends recorded video, alerts by buzzer	No	No	Yes
7	Iot based unified approach for women safety alert using gsm	sms and email alert, alerts by buzzer lightsource	Yes	No	Yes

Table 7.1: Comparison of Safety Application and Device

7.6 Application Performance

From the above table we have compared with our system. The existing systems used Native Android Development for developing a women safety application. And we have used Flutter Framework which is much better than the Native Android Application and also supports cross platforming. The CPU usage determines the performance of the application how it well process the data, how it swiftly responds to the user inputs. Below is the comparison of Native Android and Flutter App fig 7.1. It clear shows that Flutter takes less time to compute rather than Native Android App.

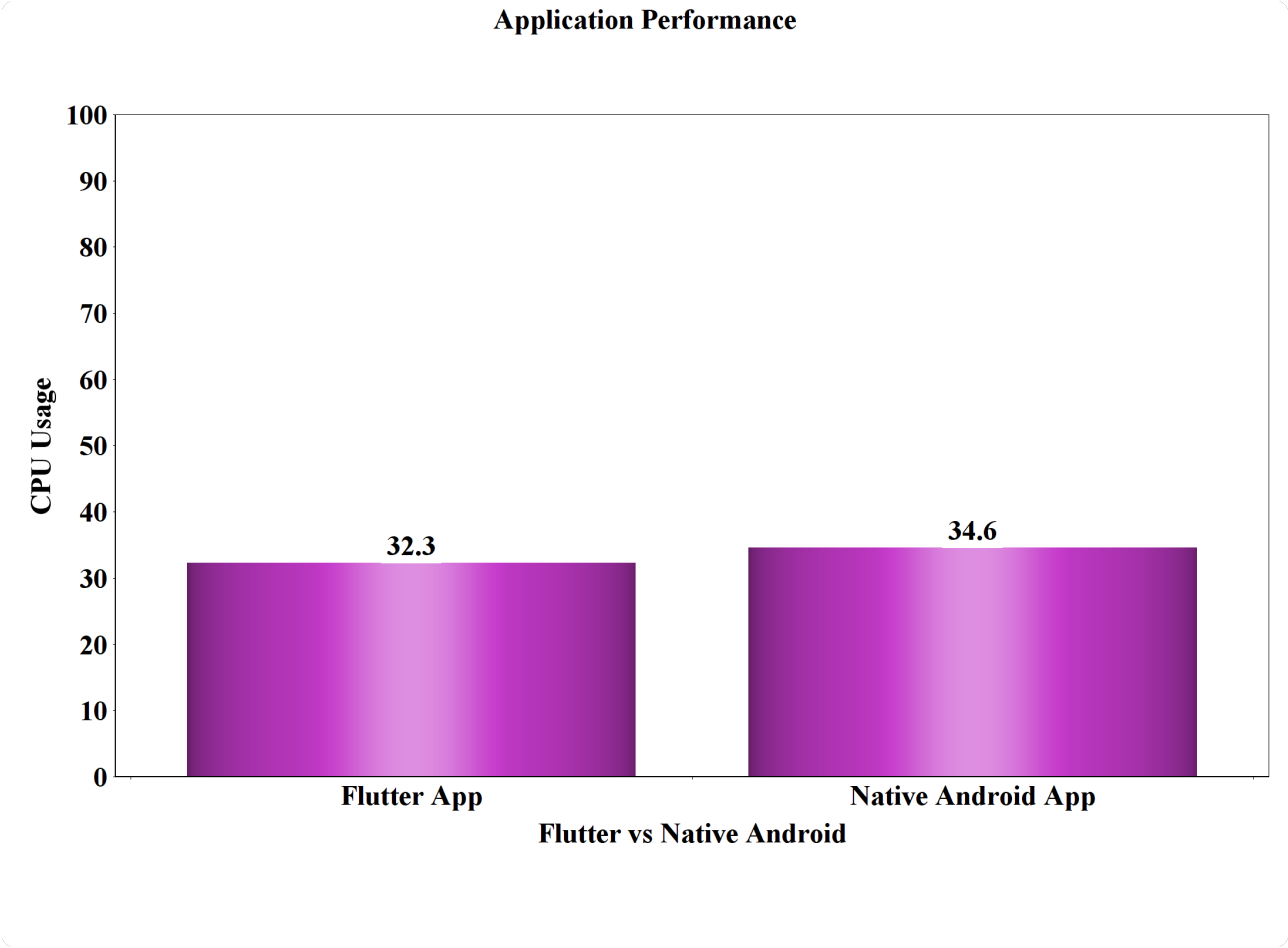

Figure 7.6: Application Performance

Chapter 8

Conclusions and Future Scope

Women's progress plays a crucial role in any country moving ahead. Still, several women are experiencing various problems like harassment, abuse and many more. Considering this situation, we have designed a system that will help women during an emergency and make them feel safe and secure. The proposed system will include GSM, GPS and Bluetooth modules, with an Arduino Nano and a cross-platform application. The system consists of two parts IoT band and application. The IoT band will work when the user presses the button. It will send an SMS and the current location as a google map URL link to the emergency contacts. The IoT band can also work independently without the application. The application has a feature that shows the users nearest safe locations like hospitals, police stations and crowded areas. It will store the data where the emergencies occurred in the Firebase. Finally, our system will be helpful for women in need as well as for other people during an emergency. The band size can reduce with the help of PCB by putting the essential components on it like a micro-controller, GPS, GSM and Bluetooth IC's(Integrated chip). The App can have other features like a live tracking dashboard interface. Safety bands are not just for women but also used by anyone. As more incidents occur, victims can protect themselves by wearing this band instance during an emergency, such as robbery or a car accident. The user can contact their family for help without making a phone call just by using our application. It will respond by sending the victim's current location. The application makes it easier to send the position without the attacker's knowing. It's convenient because the user can select who receives the message, usually someone that the user knows.

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Appendices

Appendix-A: Flutter Download and Installation

1. Download flutter sdk from
https://docs.flutter.dev/development/tools/sdk/releases?tab=windows

2. Place flutter sdk in your desired directory; like **/user/Documents.**

3. Go to environment variable set path for flutter.

4. Run flutter doctor

5. Download Android Studio from
https://developer.android.com/studio

6. Double click .exe file for installation.

Appendix-B: Arduino IDE Download and Installation

1. Download Arduino IDE Software from
https://www.arduino.cc/en/software

2. Unzip rar file and Install it.

Appendix-C: Packages for App implementation

https://pub.dev/packages/flutter_phone_direct_caller

https://pub.dev/packages/firebase_auth

https://pub.dev/packages/telephony

https://pub.dev/packages/geolocator

https://pub.dev/packages/flutter_blue

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